weights be applied. The danger which might arise from this fact does not appear to have been at one time duly estimated; and when smaller engines were used than at present, and the axles were differently cranked, the author thinks there is reason to believe that the accidents which not unfrequently occurred with these engines (some of them attended by fatal results) were due to this cause. The fact seems first to have been brought prominently under the notice of engineers by the experiments of Mr. George Heaton of Birmingham, who caused a falsely-balanced wheel to roll round the periphery of a circular table, by means of an axis fixed to a pivot in its centre, and thereby exhibited the tendency to jump created by even a small displacement of the centre of gravity.

The analytical investigation in this paper shows how carefully the crank should be counterbalanced to provide the requisite security against the jumping of the wheel. It appears, that, assuming the weight of an engine to be from 20 to 25 tons, and of a pair of six-feet driving wheels from $2\frac{1}{2}$ to 3 tons, a displacement of the centre of gravity of the wheel of about 3 inches from its centre would be sufficient to cause it to jump at any instant when it attained a speed of sixty miles an hour.

A table is given in the paper of the displacements of the centre of gravity necessary to produce jumps at different speeds. These vary inversely as the squares of the speeds.

Before a jump can take place, there must be a slip of the wheel, or at least the wheel must cease to bite upon the rail; and to this cause, as well as to the reciprocating action of the two pistons, the author considers may be due some portion of that fish-tail motion which is familiar to railway travellers. The calculations show the danger to be increased as the diameter of the driving wheel is diminished, and they are unfavourable to the use of light engines.

March 20, 1851.

SIR BENJAMIN C. BRODIE, Bart., Vice-President, in the Chair.

A paper was in part read, entitled "On the Anatomy and Physiology of Salpa and Pyrosoma." By Thomas H. Huxley, Esq. Communicated by Ed. Forbes, Esq., F.R.S. Received February 26, 1851.

March 27, 1851.

SIR RODERICK I. MURCHISON, V.P., in the Chair.

The reading of Mr. Huxley's paper "On the Anatomy and Physiology of *Salpa* and *Pyrosoma*," commenced at the previous meeting, was concluded.

The object of the author in the present paper is to inquire into the true nature of the singular phænomena of reproduction in the

Salpæ, whose existence was first demonstrated by Chamisso twenty years ago, and which have formed the basis of the theory of "alternate generations."

The author refers to M. Krohn as the only writer who has previously entered thoroughly into this subject; but while he bears testimony to the extreme accuracy of M. Krohn's statements, he submits that, as the latter are published in a very condensed form only, and without figures, they cannot affect any value that may attach to his own independent researches.

The forms of *Salpa* examined were the *S. democratica* and *S. mucronata*.

The author first describes their outward form, and shows that they are so different in appearance and in some points of organization, as to fully warrant the assumption (if they belonged to any other family) that they are different species. He then proceeds to describe the various organs in detail; first, however, discussing the proper nomenclature of the sides and ends of these animals, a subject on which much confusion has prevailed. Particular attention is called to the existence of an organ hitherto undescribed—a cylindrical, elongated body, like an internal shell,—here termed the "*endostyle*," which lies in the dorsal sinus, and has hitherto been confounded with the "dorsal folds" of Savigny. A peculiar system of delicate transparent vessels, taking its origin in the stomach and ramified over the intestine, is described and its nature inquired into.

The organs of reproduction are next inquired into. The young in the *Salpa democratica* constitute a "Salpa-chain," and are shown to arise by *gemmation* from a tubular diverticulum of the vascular system of the parent. In the course of their development they take the form of the *S. mucronata*.

The young in the *Salpa mucronata* again is shown to be solitary, and attached to one point of the respiratory chamber of the parent by an organ which exactly represents in its structure a rudimentary mammiferous placenta, except that in the *Salpæ* the "villus" is formed by the maternal system, the "placental cell" by the fœtal system. But the fœtus here is not produced by *gemmation*, as in the preceding case, but by a true process of *sexual generation*.

Every *Salpa mucronata* contains at one period of its existence a solitary ovum, and a testis, which is a ramified gland surrounding the intestine, and hitherto confounded with the liver. The solitary ovum becomes fertilized, pushed out into the respiratory cavity of the parent, and remains connected with the latter until it has assumed the form of the *Salpa democratica*, when it becomes detached.

Chamisso's formula therefore, "that the parent *Salpa* produces an offspring different from itself, which again produces an offspring different from *itself*, but similar to its parent," is perfectly correct, only the word "produce" has two meanings—in the one case signifying *a process of gemmation*, in the other of *true sexual generation*.

The author next proceeds to describe the anatomy of *Pyrosoma*, and to point out its general harmony with that of *Salpa*. He shows

the existence of an endostyle—a system of ramified intestinal tubules—and of other organs precisely resembling those described in the latter genus. The "hepatic organ" of Savigny is the testis, while the female generative organ consists of solitary pedicillate ova. The arrangement of their parts is essentially the same as in *Salpa*, only that the fœtus does not appear to be developed in placental connexion with the parent.

The *Pyrosomata* increase by gemmation also, but the gemmæ are solitary and do not form chains, becoming developed like those of the ordinary compound Ascidians between the pre-existing forms.

In the next section, the zoological relations of the *Salpæ* and *Pyrosomata*, with the other Ascidians, are inquired into. The author endeavours to show that there is no essential difference of organization between the ordinary Ascidians and the *Salpæ*; that the two forms grade insensibly one into the other; and that there is, therefore, no ground for breaking up the great ascidian family into the two subdivisions of Monochitonida and Dichitonida.

With regard to the theory of the "alternation of generations," the author submits that it is by no means a proper expression for the phænomena presented by the *Salpæ*. According to the author's view, the two forms of *Salpa* are not two generations of distinct individuals, but are, properly speaking, organs, and only when taken together, equivalent to an individual, in the sense in which that term is used among the higher animals.

For these pseudo-individuals, in this and all analogous cases, the author proposes the name of "*zoöids*," simply for the purpose of avoiding the apparent paradox of calling these highly-organized independent forms "*organs*," though such, in the author's opinion, they really are.

The following letter, addressed to S. Hunter Christie, Esq., Sec. R.S., by James Glaisher, Esq., F.R.S., "On the Extraordinary Fall of Rain in the neighbourhood of London on the 15th instant," was read.

"13 Dartmouth Terrace, Blackheath.
1851, March 27.

"My dear Sir,—The fall of rain in the neighbourhood of London on the 15th instant was so remarkable, that I think an account of it will be interesting to the Fellows of the Royal Society.

"At Greenwich it commenced falling about 1 o'clock A.M., and by 9^h A.M. the amount fallen was 1 inch, and by 4 o'clock P.M. at the Royal Observatory 1·45 inch was measured; at Lewisham the fall was 1·725 inch; in London an inch nearly had fallen by 9^h A.M., and by 4^h P.M. the amount collected was 1·25 inch.

"These quantities are unusual at any season, but particularly so in the month of March; there is no record either in the MSS. of the Royal Observatory, or in the Philosophical Transactions, of so large a fall in any day in the month of March, and, so far as I can find, it is unprecedentedly large.

"The annexed table shows the amount of rain fallen on this day at various places in England and Ireland.